MATHEMATICAL MODELLING FOR DEGRADATION OF WATER POLLUTION BY EFFECTIVE MICROORGANISM (EM) IN RIVER

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Specially dedicated to

My beloved father, Yusuf Bin Othman and my beloved mother, Ruslaini binti Amir. Thank you to my supervisor, Professor. Dr Zainal Abdul Aziz and those people who have guided and inspired me throughout my journey of education.

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ABSTRACT

Water quality has received considerable attention in allocation processes for maximizing the satisfaction of various sectors. However, pollutant impurities that impede adequate supply of water have a detrimental effect on the quality and harmful for living organisms. For the reduction of water river pollution level, various chemical and biological treatments are available but most of them are costly and non-eco-friendly. However, effective microorganism (EM) technology can save the cost and safely able to purify and clean rivers pollution. Therefore, mathematical model for river pollution has been developed and the effect of EM on the degradation of pollutant in river is studied. The model equations consist of a system of three one dimensional non-linear partial differential equations (PDE). A mathematical model has been simulated to describe degradation of pollutant in river. By using MAPLE software, explicit finite difference method is used to solve the system of non-linear PDE. To see the effect of addition of EM on river pollution, the three cases need to be considered where three different initial bacterial concentrations ($25mgL^{-1}$, $50mgL^{-1}$and $75mgL^{-1}$) are used. Based on the results, a low concentration of pollutant can be achieved in shorter distance and time when higher bacterial concentrations applied.

Keywords: Water river pollution, mathematical model, EM (effective microorganism), advection diffusion equation (ADE), microorganism growth rate model, one dimensional non-linear partial differential equation, explicit finite difference, MAPLE

ABSTRAK

Kualiti air telah menerima perhatian dalam proses peruntukan untuk memaksimumkan kepuasan pelbagai sektor. Disamping itu, pencemaran telah menjejaskan kualiti bekalan air dan berbahaya kepada organisma hidup. Bagi pengurangan tahap pencemaran air sungai, pelbagai rawatan kimia dan biologi boleh didapati tetapi kebanyakan mereka adalah mahal dan bukan mesra alam. Walau bagaimanapun, teknologi mikroorganisma berkesan (EM) boleh menjimatkan kos, selamat dan mampu untuk membersihkan pencemaran sungai. Oleh itu, model matematik bagi pencemaran sungai telah dibangunkan dan kesan EM terhadap pengurangan pencemar dalam sungai dikaji. Persamaan model terdiri daripada sistem tiga persamaan non-linear satu dimensi pembezaan separa (PDE). Model matematik telah simulasi untuk menggambarkan degradasi bahan pencemar dalam sungai. Dengan menggunakan perisian MAPLE, kaedah Explicit finite difference digunakan untuk menyelesaikan sistem non-linear PDE. Untuk melihat kesan penambahan EM terhadap pencemaran sungai, tiga kes perlu dikendalikan di mana tiga berbeza kepekatan awal bakteria ($25mgL^{-1}$, $50mgL^{-1}$and $75mgL^{-1}$) digunakan. Berdasarkan keputusan, kepekatan rendah pencemar boleh dicapai dalam jarak dan masa yang pendek apabila kepekatan bakteria yang lebih tinggi digunakan.